

TECHNOLOGY STRATEGY AND DEVELOPMENT IN THE COMMONWEALTH

A REPORT TO THE GOVERNOR
AND THE VIRGINIA GENERAL ASSEMBLY

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I. INTRODUCTION

For decades, the Commonwealth of Virginia has been an innovator in the use and development of technologies and technology industries. As a leader in these areas, the Commonwealth has achieved national recognition for its history of innovation. From the establishment of the Center for Innovative Technology in 1984 to the innovative IT reform effort and the creation of the Virginia Information Technologies Agency in 2003, Virginia continues to set the standard for fostering the development of technology industries and the application of technology to the business of government.

Of all of the Commonwealth's accomplishments in technology, the most noteworthy "first" for Virginia's state government was the creation of the Cabinet-level Secretary of Technology by Governor James S. Gilmore in 1998. The Secretary of Technology was originally established to serve as the Chief Information Officer of the state and to oversee the IT resources of state government.

Under the leadership of Governor Mark R. Warner, the Secretary of Technology has been given a more encompassing mission, with a vision to ensure that Virginia is a leader in the global digital economy. To this end, the Secretary of Technology serves as the key contact within the Governor's Cabinet overseeing the appropriate application of technology to the business of government and coordinating strategy among government, academia and the private sector to enhance the growth of technology industries, specifically emerging technologies such as nanotechnology and biotechnology as well as broadband communications services, in Virginia. From the vantage point of a Cabinet member, the Secretary of Technology can guide government executives on their use of technology as well as companies on their research and development initiatives.

This report is a response to the challenges facing not only the Secretary of Technology, but the challenge Virginia faces in a global 21st century information-age society driven by technology. To articulate a more complete picture of technology in the Commonwealth today and the challenges that lie ahead, this report also has been developed to meet the requirements contained in Section 2.2-225 of the Code of Virginia requiring the Secretary of Technology for the Commonwealth of Virginia to:

1. Deliver a biennial report on the technology strategy as related to research and development goals for industry, academia and government in the Commonwealth.
2. Deliver an annual report on broadband communications services, high-speed data services and Internet access throughout the Commonwealth and future deployment potential.

These reports have been consolidated to allow for the integration of relevant information between the two and to offer a strategic roadmap for the Office of the Secretary of Technology. The combined report is structured as follows:

▪ Introduction	Section I
▪ Research and Development Priorities	Section II
▪ Broadband Communication Services	Section III
▪ Return on Innovation	Section IV
▪ Information Technology Reform	Section V
▪ Conclusion	Section VI

The Office of the Secretary of Technology intends to work closely with its two operating agencies, the Center for Innovative Technology and the Virginia Information Technologies Agency, in the months ahead on implementing this strategic roadmap. Specific implementation efforts will be undertaken by CIT and VITA as follows:

- Virginia's Center for Innovative Technology (CIT): CIT serves as Virginia's strategist and implementation arm for services and investments that ensure that the Commonwealth can develop new economic engines and remain at the forefront of technological advances. Entering its 20th year, CIT remains a nationally recognized model for accelerating technology economies. CIT will be responsible for Research and Development Priorities, Broadband Communication Services, and Return on Innovation
- The Virginia Information Technologies Agency (VITA): VITA was created as part of the Commonwealth's IT reform efforts. The reform effort, focused on the efficiency and effectiveness of information technology in Virginia's state government, has resulted in the consolidation of all IT services and IT employees into VITA. VITA will continue to be responsible for implementing the Information Technology Reform efforts, including the efforts through the public-private partnership act (PPEA) to modernize the IT systems that help run Virginia's state government.

The following sections of this report provide a detailed review of the strategy, approach and impact that the Secretary of Technology's organizations will continue to deliver to the Commonwealth of Virginia.

II. RESEARCH AND DEVELOPMENT PRIORITIES

Virginia's Center for Innovative Technology (CIT), in conjunction with the Virginia Research and Technology Advisory Commission and the Virginia Biotechnology Commission, is focused on accelerating the development of three specific areas of research and development and subsequent high-tech industry creation. These areas are:

- A. Nanotechnology
- B. Life Sciences
- C. Defense and Homeland Security

These areas were chosen for their ability to advance from significant research programs to cluster communities containing research and industry.

While it is recognized that additional areas such as biodefense and modeling and simulation can become significant industry clusters within the state, the lack of funds to pursue these areas has caused them to be omitted from this review.

The next three sections of this report will provide for each research area the following information: a background on the core science, an assessment of the opportunity, a description of programs under way and projected benefits to be achieved.

A. NANOTECHNOLOGY

INTRODUCTION

Nanotechnology, described as research and technology at the atomic, molecular, and macromolecular levels, is expected to be the next significant enabling technology, affecting nearly every industry. Materials exhibit new and unique properties at the nanoscale. For example, carbon nanotubes, a previously unknown form of carbon, are about 100 times stronger and six times lighter than steel. The ability to control and manipulate material properties at this scale will dramatically transform technology sectors such as defense, communications, electronics, energy, health care, manufacturing and transportation. Nanotechnology is already present in consumer and commercial products. Products available today that benefit from the unique properties of nanoscale materials include car bumpers and mirrors, protective and glare-reducing coatings for glasses, sunscreens and cosmetics, sporting goods, and stain-free clothing and mattresses.

Analysts project that by 2015, nanotechnology will be a \$1 trillion market worldwide, supporting two million workers, 800,000 to 900,000 of whom will be employed in the United States.¹ Despite its great promise, the full potential of nanotechnology cannot be realized until two critical challenges are met:

1. The need to cost-effectively manufacture large volumes of nanomaterials.
2. The need to develop a trained nanomanufacturing workforce.

With existing strengths in research and nanomanufacturing, Virginia has the opportunity to become a national and international leader in nanomanufacturing, with the potential to capture the corresponding significant, long-term economic benefits.

NANOTECHNOLOGY IN VIRGINIA

Virginia's educational institutions are actively engaged in nanotechnology research and are partnering with industry and government labs. Eleven universities in Virginia are active in nanotechnology research and education, and substantial collaboration exists between industry and federal labs in Virginia. Examples of this research are:

- Virginia Tech researchers discovered a process for an entirely new class of carbon fullerenes encapsulating various metal and rare earth elements. Luna Innovations, Inc., based in Blacksburg, has the exclusive rights to these unique nanomaterials, which show promise for improving communication devices, producing energy, increasing the sensitivity of magnetic-resonance imaging (MRI) scans and simultaneously identifying and attacking individual cancer cells.

¹ National Science Foundation, M.C. Roco, *National Nanotechnology Initiative and a Global Perspective*, 2002

- The College of William & Mary has developed a laser process for significantly increasing the quality and the production rate of carbon nanotubes and is working with the Free Electron Laser at the Thomas Jefferson National Accelerator Facility to scale up the process.
- NASA Langley Research Center has developed an approach for controlling the deposition and alignment of carbon nanotubes for electronic applications.
- The University of Virginia is host to a prestigious National Science Foundation Materials Research Science & Engineering Center, the Center for Nanoscopic Materials Design.
- Virginia Commonwealth University is actively engaged in nanoscale biosensors, biochips and nanoneurosurgery.
- James Madison University has educational outreach programs and active research in its labs on chip, sensors and molecular scaffolds.

Virginia's large and small companies are also engaged in the creation and application of nanotechnology. Examples of successful spin-outs from intellectual property created by Virginia universities include Luna NanoWorks of Danville, which was spun out from Luna Innovations in November 2004, and NanoSonic, Inc. of Blacksburg. Both companies have received national attention from the press and scientific community. Large companies in Virginia such as BAE Systems, Lockheed Martin Corp., Philip Morris USA and Northrop Grumman Newport News will be greatly impacted by nanotechnology, especially in the areas of nanoelectronics, sensors, coatings and filters. They are actively developing in-house capabilities as well as partnering with academia and small companies.

In FY2002, CIT created the Virginia Nanotechnology Initiative. VNI, previously named the Initiative for Nanotechnology in Virginia, is an alliance of interests from academia, industry and the public sector serving the nanotechnology community across the Commonwealth. VNI facilitates collaboration to advance Virginia's nanotechnology research, creates conditions to accelerate technology transfer to industry, furthers educational and workforce training programs in nanotechnology, and seeks to position Virginia at the forefront of nanotechnology innovation. CIT has invested \$477,000 in VNI, with \$147,000 of that amount invested in FY2005.

A NATIONAL NANOTECHNOLOGY PERSPECTIVE

In December 2003, the United States affirmed its commitment to nanotechnology by enacting the nearly \$3.7 billion 21st Century Nanotechnology Research and Development Act. Governments, corporations and venture capitalists will spend more than \$8.6 billion worldwide on nanotechnology research and development in 2004.² Given this economic

² *The Nanotech Report 2004*, Lux Research

opportunity, more than 25 states have nanotechnology initiatives designed to capture and lead this nascent sector. New York, for example, has committed more than \$500 million to the Albany NanoTech program at the State University of New York at Albany. Texas Governor Rick Perry recently announced a \$40 million state investment in an Advanced Materials Research Center at the University of Texas at Austin, which is expected to result in 4,000 high-tech jobs over the next 10 years. Pennsylvania has invested \$37 million in The Nanotechnology Institute, a Philadelphia-based partnership led by the Ben Franklin Technology Partners of Southeastern Pennsylvania, Drexel University, and the University of Pennsylvania, with significant investments also to other Pennsylvania institutions of higher education including Pennsylvania State University and Lehigh University.

VIRGINIA'S NANOTECHNOLOGY STRATEGY

Virginia has a strong nanoscience research community. Virginia also is home to important start-up companies as well as a broad range of industries that are or will be users of nanotechnology in order to be competitive. To propel Virginia into a leadership position, however, a significant and targeted investment is required.

Shortly after its creation in 2000, the Virginia Research and Technology Advisory Commission (VRTAC) identified nanotechnology as a strategic research priority for the Commonwealth. In May 2003, VRTAC asked CIT to develop a vision for nanotechnology research in Virginia. CIT and the statewide consortium now called VNI recommended nanomanufacturing as the area in which Virginia could establish leadership. In September 2003, VRTAC endorsed nanomanufacturing as the Commonwealth's strategic priority within nanotechnology.

At VRTAC's direction, CIT is developing strategic initiatives to position Virginia as a leader in nanomanufacturing and achieve a unified vision for nanotechnology in FY2005. A direction shared and advocated by a broad base of stakeholders in academia, industry and government in Virginia will drive commitment and achievements. CIT's longer-term goal is to foster the creation of nanomanufacturing clusters in Virginia. CIT's Research Investment team leads this activity. The VNI assists with increasing the flow of federal research funding into Virginia and builds a coordinated nanotechnology community.

Key activities for CIT and VNI in FY2005 include profiling the domestic and international competitive landscape, identifying Virginia's nano-related technical facilities and assets, developing a roadmap to develop a nanotechnology cluster(s) in Virginia, and conducting regular education and awareness programs with Virginia's corporate, government and academic decision makers.

At VRTAC's request, CIT developed a concept for a phased investment in nanotechnology. CIT's recommendation, which VRTAC endorsed in November 2004, calls for a multi-pronged, multi-year investment. Four investments are recommended:

1. An area of immediate strength for Virginia with a clear market opportunity, where intellectual property created in Virginia will be developed and produced in Virginia.
2. Research infrastructure, particularly in the creation of a network that allows researchers across the state to use instrumentation not present in their own organization.
3. Future workforce education and training program development.
4. Support infrastructure to coordinate and oversee these projects.

Nanotechnology is the largest federal science and technology investment since the space race, and it is clear that strong competition exists for leadership. States are investing heavily due to the enormous promise for economic return that comes with dominance. Investments are critical because so much remains unknown and nanotechnology requires breakthroughs in fundamental knowledge. Nanotechnology is capital intensive, and most individual institutions and companies cannot acquire and maintain the required equipment. Further, nanotechnology's future workforce will require new skill sets.

Advances that position Virginia in the forefront of nanotechnology and lead to cluster development cannot be attained without significant new funding. Although the federal government remains the primary funding source for nanotechnology, the federal government expects and often requires leverage for its investment from prior state commitments. As cited in the Life Sciences section of this report, a \$14 million investment by the Commonwealth and the Virginia Tobacco Commission in the Virginia Bioinformatics Institute (VBI) at Virginia Tech has led to \$43 million in federal R&D contracts for VBI. Virginia's investment in nanotechnology will stimulate innovations in research, commercialization and workforce development and will be multiplied many times over through additional federal and industry commitments.

ECONOMIC OPPORTUNITY

With a targeted investment, Virginia can become an international leader in nanomanufacturing and reap the economic benefits that come with leadership. An investment in research, research infrastructure and workforce training and education can increase R&D expenditures at Virginia colleges and universities, create and attract companies, and generate jobs. State investment in nanotechnology also would boost Virginia's reputation as a leader in this lucrative, job-creating technology.

VRTAC concurs that the Commonwealth can achieve significant, measurable impact from investing in nanotechnology. CIT has projected the impacts of two possible options for investment in nanotechnology in FY2006: \$5 million or \$20 million.

A potential \$5 million investment in developing carbonaceous nanomaterials for the MRI contrast agent market could lead to \$50 million in research and economic return. This

projection includes salaries, benefits and facilities of up to \$4.6 million for at least 15 new employees in FY2006 in the Danville area. Between FY2006 and FY2010, the economic impact from payroll and federal research grants from programs such as the Small Business Innovative Research program (SBIR) and the Advanced Technology Program (ATP) could lead to a return of \$21 million. In addition, CIT projects an increase of \$29 million in R&D expenditures at Virginia colleges and universities during the period between FY2006 and FY2010, as well as the creation of one company and the attraction of four others.

A potential \$20 million investment in nanotechnology would accelerate and broaden the resulting research and economic impact. This larger sum would permit three investments in nanotechnology research and commercialization as well as increased investments in research infrastructure and future workforce education and training. Between FY2006 and FY2010, Virginia could realize nearly \$147 million in research and economic return. CIT projects returns of more than \$70 million in research expenditures at Virginia colleges and universities, and \$76 million in salaries, benefits, facilities, private investment and federal grants to companies. In both cases, CIT anticipates but has not projected the value of capital investment attributable to the Commonwealth's nanotechnology initiative.

CIT projects that a \$20 million investment could lead to the creation of 11 companies and the attraction of 10 companies during the period FY2006-FY2010. Because an investment of this scale would accelerate the development of a critical mass, and since the nanotechnology market will dramatically increase in seven to 10 years, Virginia would receive a much greater long-term payoff than with the smaller investment.

CONCLUSION

Virginia has a skilled workforce, a solid research foundation, and a broad industrial base of users of nanotechnology. With a strategic investment in this promising technology, Virginia can anticipate tens of thousands of new jobs in rural and urban areas of the state.

B. LIFE SCIENCES

INTRODUCTION

Many of the dramatic advances in life sciences in recent decades have been made possible by the use of computing technology to process digital information obtained in forms such as gene sequences, imaging data, clinical trial data and community health data. The convergence of biosciences and information technology is increasingly evident in fields such as genomics, proteomics, bioinformatics, systems biology, medical imaging, clinical decision support and disease outbreak surveillance.

The markets at the intersection of the life sciences and IT are estimated at \$176 billion worldwide in 2005, and they are expected to grow to more than \$240 billion by 2010.³ Research funding in the bio-IT intersection is growing, with an estimated \$6.8 billion spent worldwide in 2005, and that is expected to grow to \$16 billion by 2010.⁴ U.S. federal funding for bio-IT research is expected to total more than \$1.6 billion in the final FY2005 budget.⁵ The fastest growing category of the biotechnology workforce is that of bio-IT computer specialists, which were recently measured at 6.2% of the biotech workforce and growing at 22% annually.⁶ These are high-paying jobs, with starting annual salaries ranging from \$65,000 to \$90,000.

In FY2004, CIT identified these opportunities at the intersection of life sciences and IT as a strategic target, dubbed “SmartBio,” for a state initiative leveraging Virginia’s existing research and commercialization strengths in these areas. Acting on a recommendation of its November 2003 report, with the addition of this identified target area, the Governor’s Commission on Biotechnology (“Biotech Commission”), including representatives of the state’s biotechnology industry, academia, and government, has developed a plan for a comprehensive program, SmartBio Partnerships (SBPs), integrating the following:

- Research to better understand complex biological systems.
- Commercialization support to accelerate research results into practical, beneficial products and companies in human health, veterinary medicine, agriculture, public safety and environmental stewardship.
- Future workforce development to support a sustainable cluster of SmartBio industry in Virginia.

Effective collaboration among the Commission’s leadership—the Secretary of Commerce and Trade, the Chair of the Virginia Biotechnology Association (VaBIO), and the

³ *Bioinformation Market Study for Washington Technology Center*, 2003, Alta Biomedical Group

⁴ *Ibid.*

⁵ CIT analysis of Bio-IT R&D research in federal agencies based on [AAAS Report XXIX: R&D FY 2005](#) and *Updated Status of FY2005 Appropriations*, Nov. 3, 2004

⁶ U.S. Department of Commerce, 2003. *A Survey on the Use of Biotechnology in U.S. Industry*, pp.81-84

Secretary of Technology—has proven essential in developing and advancing this bold initiative.

SMARTBIO IN VIRGINIA

Virginia's strong IT industry—6th in IT employment⁷ among the states—provides SmartBio-relevant strengths in data integration/fusion, data mining and analysis, intelligence, decision support, modeling and simulation, networking and Internet technologies, information security and privacy. Companies integrating IT and life sciences disciplines are beginning to grow in Virginia, including firms focused on bioinformatics, forensic sciences, genomics/proteomics, imaging and telemedicine, as well as clinical research organizations and health care systems.

Virginia ranks 17th among the states in combined Life Science, Math and Computer Science R&D expenditures at its institutions of higher education.⁸ SmartBio research and educational assets in Virginia include:

- Virginia Tech's Virginia Bioinformatics Institute (VBI).
- The University of Virginia's Computational Biology program.
- VCU Life Science's Center for the Study of Biological Complexity.
- George Mason University's Centers in Biomedical Genomics and BioDefense.
- The College of William & Mary's Biological Mathematics program.
- Eastern Virginia Medical School's Center for Biomedical Proteomics.

Networked, high-speed computing assets such as Virginia Tech's Terascale Computing Facility and the College of William & Mary's SciClone Cluster will be significant for SmartBio research and collaborations among state institutions. Additional SmartBio-relevant research strengths reside in Virginia's federal and state government laboratories and non-profit research institutions such as the Carilion Biomedical Institute in Roanoke.

The state has already begun to invest in the bio-IT arena. In 1999, an investment of \$14 million from the Virginia Tobacco Commission and the Commonwealth Technology Research Fund (CTRF) created the Virginia Bioinformatics Institute at Virginia Tech, which in five years has developed a federal R&D contract base of more than \$43 million. In July 2004, VBI was awarded \$10.3 million by the National Institute for Allergy and Infectious Diseases to establish one of six national Bioinformatics Research Centers. Similarly, a \$3.2 million CTRF award attracted INCOGEN, a bioinformatics company, to relocate to Williamsburg in 2001. This CTRF award also has resulted in new employment, Phase I and II SBIR awards, and R&D collaborations with VBI, the College of William & Mary, Eastern Virginia Medical School, Duke University and Johns Hopkins University.

⁷ American Electronics Association's *CyberStates 2003*

⁸ National Science Foundation, *Academic Research and Development Expenditures: Fiscal Year 2002*, NSF 04-330,, 2004

A NATIONAL LIFE SCIENCES PERSPECTIVE

These investments are a good beginning, but further commitments are necessary if Virginia is to become a leader in the bio-IT area. The Batelle/BIO report of June 2004 identified 40 states targeting the biosciences, noting that states are increasingly targeting specific niches relative to their strengths. Kansas passed a \$500 million Kansas BioScience Initiative in April 2004, encompassing comprehensive support for life sciences research and commercialization programs. New York's NYSTAR program has invested \$50 million, with \$150 million from private and federal partners, to create the NY-Buffalo Center for Excellence in Bioinformatics. Washington State is considering investing \$450 million into a \$1.35 billion, 10-year initiative called "Bio-21" that would support research and commercialization activities at the IT-life sciences convergence. Internationally, Canada, the European Union and several Asian nations are investing hundreds of millions in bio-IT research and commercialization efforts.

VIRGINIA'S SMARTBIO STRATEGY

In November, 2003, the Governor's Advisory Board for the Virginia Biotechnology Initiative ("advisory board") reported its recommendations, including the concept of "Biotech Macro Partnerships" integrating Virginia's core technology competencies with staff and financial support to bridge the commercialization gap separating research discoveries from their development into products and companies. In early 2004, CIT identified SmartBio as a target area for development of a Virginia research and commercialization cluster, and actively vetted the SmartBio concept to university, industry and government stakeholders around the state, including VRTAC and the advisory board's successor, the Biotech Commission. These stakeholders uniformly supported the concept as having merit for Virginia. The Biotech Commission's plan to establish SmartBio Partnerships embodies both the concept of the "Biotech Macro Partnerships" recommended by the advisory board as well as the focus on SmartBio for cluster development.

The advisory board report noted that the current dynamic environment—as biotech rapidly matures—offers opportunities for Virginia to compete successfully for a leadership role in the new biosciences industry of the 21st century. SmartBio presents such an opportunity for Virginia, but other states are rapidly moving to invest as well because of the expected economic potential. Virginia can expect to become a leader in bio-IT only with a serious commitment from state government leaders and financial stimulus from the state.

The advisory board noted that while state government does not provide the resources for the entire commercialization spectrum from research ideas to successful economic impact, it is nevertheless uniquely positioned to provide a strategic, initial stimulus. A focused investment from the state, with SmartBio Partnership (SBP) selection and oversight from a body representing the interests of all stakeholders and the Commonwealth, will draw out creative proposals leveraging investments by academic,

industry, regional government and other partners. This investment will help differentiate and position Virginia for research and commercial leadership in SmartBio markets.

The Commission's plan envisions a three-year SmartBio Partnership Program to create one or more SBPs. In the plan, each SBP will be expected to conduct a program of research, commercialization and workforce development. Examples of existing Virginia research strengths in which proposals could be requested include:

- "Smart" data integration for personalized medicine.
- "Smart" analytical tools for complex biosystems.
- "Smart" biothreat detection/identification.
- "Smart" food production/environment optimization.

The SBP will drive innovative SmartBio-related research, including university-matched recruitment of "star" researchers who will expand research funding and training efforts as well as provide additional visibility and leadership. The SBP also will bridge the commercialization gap by providing coordination and support to accelerate development of "smart" products and sustainable companies from opportunities identified within existing research as well as those arising from new discoveries emerging from the SBP. Finally, these integrated partnerships will work with their regional academic institutions, universities, four-year colleges and community colleges to develop curriculum and training to meet the future workforce needs of their nascent SmartBio industry clusters.

ECONOMIC OPPORTUNITY

A focused Virginia SmartBio investment will position Virginia to become a recognized leader in the burgeoning bio-IT markets and is expected to bring significant economic benefits to the Commonwealth. A concentrated effort in SBPs will more effectively attract research funding to universities and companies, foster creation of a SmartBio industry cluster, and train the needed workforce.

CIT has projected the impacts of two options for investment in SmartBio Partnerships in FY2006: \$5 million or \$20 million.

Based on a state investment of \$5.1 million for creation of one SBP, CIT has projected that a return of \$42.1 million in research and economic impact can be achieved from FY2006 through FY2010. This amount includes a projected increase of \$21.8 million in academic research funding through federal grants and appropriations, and \$20.3 million in economic impact to companies, including SBIR/ATP grants and angel/venture capital investments. CIT projects 10 new companies would be formed, attracted or expanded into Virginia, and 200 new high-paying jobs created.

A \$20 million investment would accelerate Virginia's path to leadership in SmartBio. By providing funds for several SBPs, Virginia would spread its investments among varied bio-IT strengths around the state while fostering a unified SmartBio focus. A \$20 million concerted effort statewide would demonstrate a more substantial Virginia commitment

sooner and position Virginia to reap a greater long-term payoff as the bio-IT markets expand quickly in the next decade. Between FY2006 and FY2010, CIT projects that Virginia would receive more than \$152 million in research and economic return. This total reflects an increase of almost \$71 million in research expenditures at Virginia's colleges and universities and \$81 million in federal grants and private investments to companies. Approximately 40 new companies would be formed, attracted or expanded into Virginia and 1,000 new jobs created.

CONCLUSION

The state is well positioned to develop a leading SmartBio industry cluster if it makes a focused investment in this promising technology. Yet SmartBio is but the first of several areas of core strength on which the Commonwealth can build its future in the life sciences. Opportunities also exist for Virginia to develop leadership in areas such as biodefense and biomanufacturing. Another positive development is the creation of Howard Hughes Medical Institute's new research campus at Janelia Farms in Loudoun County, which will provide world-class research discoveries. The life sciences are ripe for commercial development in the supportive environment for technology-based economic development envisioned by the SmartBio Partnership program. Therefore, a strategic investment now in the SmartBio Partnership program will provide significant life sciences research and economic impacts to the state for years to come.

C. DEFENSE AND HOMELAND SECURITY

INTRODUCTION

Virginia's proximity to the nation's capitol places the Commonwealth in a strong position to take advantage of federal research and development programs that are funded by the Department of Defense and the Department of Homeland Security. Both federal Cabinet departments have headquarters and significant field office presence in the metropolitan Washington, D.C. area.

According to the American Association for the Advancement of Science, in FY2000 Virginia ranked third nationally in total research and development funding⁹. However, statistics show that Virginia universities receive less than 25% of the defense research funding that per capita peer states like Maryland and Pennsylvania obtain. In 2001, Maryland was reported to have received \$262 million in defense obligations for its universities, Pennsylvania universities reported \$185 million, and Virginia universities reported \$45 million.

To increase Virginia's portion of defense-related university research and provide growth opportunities for the Commonwealth's businesses, CIT proposed an institute dedicated to delivering defense and homeland security solutions, a proposal supported by the Virginia Research and Technology Advisory Commission.

In February 2003, Governor Mark R. Warner announced the creation of the Institute for Defense and Homeland Security (IDHS), a consortium of university, industry and federal R&D partners dedicated to delivering science and technology solutions in response to national defense and homeland security requirements. Underwritten by CIT, IDHS is designed to position the Commonwealth as a leader in defense and homeland security R&D and technology transition by developing Virginia assets into world-class defense research and development hubs.

INSTITUTE FOR DEFENSE AND HOMELAND SECURITY

IDHS is not a traditional research institute. IDHS is designed to fuel the Commonwealth's defense research and development growth by developing programs that leverage existing federal research and enhancing that research to solve new or different problems. This leveraged focus allows the Institute to concentrate on applied research projects that have the potential to advance to large-scale R&D programs involving Virginia universities, companies and federal labs.

Unlike traditional research institutes that perform research and employ researchers, IDHS was structured to serve as a broker of opportunities for the Commonwealth's existing research assets. In this role, IDHS management works with defense and homeland

⁹ "Federal Research and Development in the FY 2004 Budget," Kei Koizumi, American Association for the Advancement of Science, Governor's Higher Education Research Summit, May 1, 2003, Newport News, Virginia.

security program directors to discover their research priorities, identify funding availability, and unite university and industry entities to develop strong solutions. This approach reduces the initial investment required to start new research facilities, maximizes existing research assets in the Commonwealth and provides multi-university, multi-company solutions for complex national challenges.

Universities and research institutions serve as key suppliers of innovation that can contribute to solutions for the challenges faced by defense and homeland security communities. The following Commonwealth research universities are founding members of IDHS:

The College of William & Mary	Eastern Virginia Medical School
George Mason University	George Washington University
Hampton University	James Madison University
Norfolk State University	Old Dominion University
Shenandoah University	University of Virginia
Virginia Commonwealth University	Virginia Military Institute
Virginia Polytechnic Institute and State University	Virginia State University

IDHS currently has 70 industry affiliate members. Partners range in size and focus from innovative technology startups to large-scale defense integrators. Industry affiliates will be engaged in collaborative applied R&D programs with partner universities and federal laboratories, leading to product commercialization.

IDHS is housed in CIT's headquarters building in Herndon, in close proximity to the federal agencies concerned with defense and homeland security. The Institute is currently engaged in the development of programs that will leverage existing federal R&D expenditures. IDHS has proposed 'alternative use' solutions for programs in the fields of environmental biodefense, surveillance and early warning communication systems. The FY2004 federal defense budget contains more than \$3.5 million of program funds for programs initiated by IDHS. The FY2005 federal defense appropriations bill contains an additional \$2.7 million of program funds for programs initiated by IDHS. If these programs meet their current delivery and funding milestones, they will produce in excess of \$75 million of new R&D opportunities for Commonwealth entities during the next five years.

IDHS RESEARCH AND DEVELOPMENT PROGRAMS

IDHS is engaged in the development of five research programs. These developmental programs are identified areas of research important to defense and homeland security directorates that are in the initial stages of definition and funding. IDHS personnel have worked to secure federal funding to initiate these programs and are actively pursuing the development of proposals that will obligate the funds. Once funding has been awarded, a solicitation will be released to affiliate members of IDHS, and grants will be allocated to Commonwealth universities and companies to execute the initial phase of each project.

Following are descriptions of the programs in development:

Red Cell

Red Cell is an emergency alert system that leverages existing sensor and network research and development for real-time detection of chemical, biological, radiological and nuclear incidents. In FY2005-2006, IDHS' Red Cell program team will develop a concept of operations for a sensor and cellular communications infrastructure to enable comprehensive incident management by coupling state-of-the-art detection and dispersion modeling technologies to national cellular wireless networks. The Red Cell system will be able to selectively warn affected areas and populations in the event of terrorism or other emergencies such as Amber Alerts, tornado warnings, etc. IDHS management was able to secure funding for the initial phase of the Red Cell program in the federal FY2005 defense appropriation bill.

Remote Presence

The Remote Presence program will leverage existing DOD unmanned vehicle technologies for advanced military and first responder applications. In FY2005-2006, IDHS' Remote Presence program team will develop new payloads, extend endurance parameters and develop new concepts of operations for military service, homeland defense, homeland security and civilian applications. The program will focus on systems that are effective and affordable for first responders. IDHS management was able to secure funding for the initial phase of the Remote Presence program in the FY2005 defense appropriation bill.

Environmental Bioterrorism

The Environmental Bioterrorism Detection (EBD) program is a wildlife-disease monitoring network that collects and analyzes clinical data from wildlife hospitals, wildlife rehabilitation organizations, veterinarians and individuals. In FY2005-2006, IDHS' Environmental Bioterrorism program team will develop plans to couple the EBD network to a federal Epidemic Outbreak Surveillance network currently in development for human disease to provide a more complete bio-surveillance system. The program will exploit emerging defense medical technology to allow rapid pathogen identification and national alerts. IDHS management was able to secure funding for the initial phase of the Remote Presence program in the FY2005 defense appropriation bill.

Center of Excellence in Robotics

The Center of Excellence in Robotics program will support the Office of Naval Research with a series of R&D studies designed to address the direction of national robotic programs. These studies will assist the Navy in developing a technology research plan, operational employment policies, requirements documentation and acquisition strategies for robotics that meet current and emerging naval mission areas. In FY2005-2006, IDHS will foster research with the Potomac Institute for Policy Studies in Arlington in support of the Navy's robotics program awarded to Potomac Institute.

NAVCITI

IDHS, in conjunction with Virginia Tech, secured a \$3.5 million research funding extension for Virginia Tech's Navy Collaborative Integrated Information Technology Initiative (NAVCITI) research program. The NAVCITI extension will focus on research in the areas of advanced wireless networks, networking and communications technologies, including software reconfigurable radios, smart antennas and ultra-wideband systems. IDHS's efforts in extension of the NAVCITI program will enable Virginia Tech researchers to continue current research while pursuing additional funding sources for these areas.

ECONOMIC OPPORTUNITY

A focus on defense and homeland security research and development will allow the Commonwealth to greatly increase the amount of research funding Virginia's institutions receive from the federal government. This increase in research funding will serve as an economic stimulus for universities and their communities, and it will facilitate the achievement of Governor Mark R. Warner's goal of achieving a \$1 billion in university research expenditures by 2010.

Currently, CIT invests \$680,000 in the operations of IDHS annually, as well as providing facilities and administrative support services. The Institute has a goal of increasing Commonwealth research funding from defense and homeland security to \$100 million by 2007. After 21 months of operations, IDHS reports that it is on track to achieve this objective, on the assumption that the war in Iraq will not reduce federal research investments from the FY2003 level.

IDHS projects that its five research projects--Red Cell, Remote Presence, Environmental Bio-terrorism, Center of Excellence in Robotics and NAVCITI--will generate \$40 million of research funds for the Institute to allocate as grants to Commonwealth entities. Additionally, these programs are projected to generate another \$60 million in new research funding directly to Commonwealth research entities. This combined increase of \$100 million of research funding will represent a 200% increase of defense research obligations to Commonwealth entities over the levels reported in FY2001.

In order for these programs to successfully develop as large-scale research programs, IDHS will require continued funding at the current levels as well as legislative and gubernatorial support in developing strong Virginia Congressional delegation momentum to secure federal funding for these programs. Matching funds provided as either cash or in-kind services may be required to leverage federal investment in some of these programs. The need for, or the required amount of matched funds, cannot be identified at this point in the programs' development.

CONCLUSION

Virginia has successful research programs that can deliver solutions to national defense and homeland security challenges. The Commonwealth has a geographic advantage over

other states is the pursuit of these areas. Continuing investments in IDHS will position the Commonwealth to be a national leader in defense and homeland security research.

III. BROADBAND COMMUNICATION SERVICES

INTRODUCTION

Advanced telecommunications infrastructure – otherwise known as broadband networks – is the first enabling technology since electricity to fundamentally impact society to such a great extent that it is now viewed in economic development circles as “critical infrastructure” that is essential to the minimum operations of the economy and government.¹⁰ This is why the deployment of affordable, last-mile, broadband services across the Commonwealth is a priority for Governor Mark R. Warner and Secretary of Technology Eugene J. Huang.

Virginia’s research priorities—nanotechnology, SmartBio and homeland defense—and indeed its overall economic competitiveness are dependent upon having affordable ubiquitous, high-speed Internet access available to governments, educational institutions, universities, entrepreneurial ventures, corporations (large and small), students and the entire Virginia workforce.

The need for high-speed networks is particularly important in rural areas of the state that are economically depressed, since municipalities cannot retain existing businesses or attract new ones without having broadband services available. Generally, these same areas have low population density rates that deter private sector investment. It is in these depressed areas that government intervention is necessary to spark private-sector interest and investment in broadband services, in order to level the playing field for competition with urban and suburban metropolitan areas.

For the future of Virginia’s workforce, broadband access is no longer optional. In order to develop, nurture and retain the best and brightest workers for Virginia companies, it is imperative that workers (present and future) have access to broadband technologies so that educational and career development activities can be pursued.

Finally, for the citizens of the Commonwealth, broadband access affords a quality of life that has never before existed. For the young and old alike, access to broadband connectivity offers opportunities such as:

- Increased availability of learning, research and cultural opportunities.
- Access to world-class medical treatment through telemedicine.
- Flexibility of lifestyle via telecommuting.
- New opportunities for community interaction and involvement.

With these across-the-board benefits, the availability (or lack thereof) of affordable broadband services in Virginia will be a determining factor in the competitiveness of the Commonwealth in the 21st century and beyond. Foreseeing the importance that e-commerce and broadband would play in the future of the Commonwealth, CIT took the

¹⁰ Definition of critical infrastructure from the Alliance for Telecommunications Industry Solutions (www.atis.org)

lead and began offering e-commerce and broadband related services in the mid 1990s. This role was formally added to CIT's mission through budget language¹¹ passed by the General Assembly in 2003. In accordance with this budget language, CIT continues to develop resources and programs to facilitate the deployment of affordable broadband telecommunication services into underserved areas of the Commonwealth. In keeping with the requirements of the amendment, CIT presents this report that continues the documentation¹² of Virginia's progress toward ubiquitous availability of affordable broadband services.

Leadership and tenacity continue to drive the deployment of broadband services throughout the Commonwealth. Despite a tenuous economy and tight budgets, private companies, municipalities and legislators continue to find creative ways to facilitate the deployment of broadband services across the Commonwealth.

Broadband remains an enabler, an accelerator, and a catalyst. With it, social and economic development opportunities are expanded, worker productivity increases and lives are enhanced. Without it, communities find themselves on the wrong side of the Digital Divide, left to struggle while others move farther into the knowledge age.

While the need for broadband is ubiquitous, technologies are not. No single technology can meet all the challenges (population density, geography, etc.) of deploying affordable broadband solutions into non-metropolitan areas. Hybrid networks remain the best solution because they offer combinations of technologies and services rather than a one-size-fits-all solution. Therefore, each locality (neighborhood, city, town, county, state or country) needs to devise broadband strategies and deployment plans that define a technological solution that best meets current needs while remaining adaptable enough to accommodate the integration of future technical advancements, physical expansion and increasing capacity demands. The publication *Broadband Bringing Home the Bits* stated it best: "Broadband deployment is an ongoing process, not a one-time transition."¹³

¹¹ "The Center for Innovative Technology shall continue to support efforts of public and quasi-public bodies within the Commonwealth to enhance or facilitate the prompt availability of and access to advanced electronic communication services, commonly known as broadband, throughout the Commonwealth, monitoring trends and advances in advanced electronic communications technology to plan and forecast future needs for such technology, and identify funding options."

¹² The documentation process began with HJ163 – *Advancing Affordable, High-bandwidth Electronic Networks in Rural Virginia*, a report published in 2002 by The Secretary of Technology and Virginia's Center for Innovative Technology.

¹³ Washington, D.C.: National Academy Press, 2002.p.163

BROADBAND DEPLOYMENT IN VIRGINIA – RANKINGS AND DATA

In the most recently published (2003) state broadband deployment rankings, Virginia placed favorably in the categories of policy and infrastructure deployment.

In *The State Broadband Index*, a study conducted by Technet¹⁴, Virginia ranked 8th for “showing leadership in clearing roadblocks to broadband deployment and adopting innovative policies that foster demand for the benefit of their citizens and industry.”¹⁵

In this report, TechNet examined the key role states can play in the availability of broadband telecommunication services. The report ranks the top 25 states based on the extent to which the public policies spur (or impede) broadband deployment and demand. The index calls on states to consider a range of deployment policy areas including:

- Legislation that standardizes and expedites rights-of way permitting.
- Adoption of a statewide broadband strategy and creation of a lead broadband agency.
- Comprehensive infrastructure mapping.
- Policies to enable wholesale municipal networks.
- Innovative initiatives that increase private-sector deployment.
- Financial incentives to reach underserved communities.
- Demand-promotion efforts including enhanced e-government.

States joining Virginia in the *Broadband Index* “Top 10” are:

1. Michigan
2. Florida
3. Missouri
4. Texas
5. Ohio
6. Washington
7. Kansas
8. Virginia
9. Colorado
10. Iowa

¹⁴ TechNet is a national network of more than 200 CEOs and senior executives in the high technology and biotechnology industries.

¹⁵ Quote from TechNet’s President and CEO Rick White, referring to the states at the top of the Broadband Index.

A second report, *Broadband in the States 2003* by the American Electronics Association (AEA), is based on broadband deployment data collected by the Federal Communications Commission.¹⁶ Based on their analysis of the FCC data, AEA ranked Virginia as follows:

- 14th in Broadband Subscribers.
- 39th in Broadband Growth Rate (12-2001 through 6-2002).
- 25th in Broadband Subscribers per 1,000 households.
- 11th in Home Internet Access (all types).

Compared to other Eastern states, Virginia's broadband statistics are as follows:

State	State Population	Total Broadband Subscribers	Cable	DSL	Other	Dec. 2001 to June 2002 Subscriber Growth Rate
Massachusetts	6,379,304	583,627	391,391	147,139	43,097	15%
Virginia	7,187,734	360,722	238,300	75,524	46,898	23%
Maryland	5,375,156	316,666	181,864	95,439	39,363	21%
North Carolina	8,186,268	431,736	313,884	89,680	58,172	29%

Data collected by the Federal Communications Commission (FCC) offers another measure for gauging the progress Virginia has made in broadband communications deployment. In March 2000, the FCC adopted the local competition and broadband data-gathering program to assist the FCC in its efforts to monitor and further implement the pro-competitive, deregulatory provisions of the 1996 Telecommunications Act.

FCC data (collected through this process) remains the standard by which progress toward ubiquitous broadband is measured. Data reported by the FCC reflects the extent to which facilities-based providers¹⁷ have provisioned high-speed connections as collected on FCC Form 477¹⁸.

¹⁶ The data collected by the FCC represents only those services with over 200 kilobits per second in at least one direction.

¹⁷ Reporting of state level data is required for providers with at least 250 high-speed connections in service in a state.

¹⁸ The report is available for reference in the FCC's Reference Information Center, Courtyard Level, 445 12th Street SW, Washington, DC. Copies may be purchased by calling 800-378-3160 or downloaded from the FCC-State Link Internet site at www.fcc.gov/wcb/stats

For reporting purposes, the FCC segregates broadband into two distinct categories:

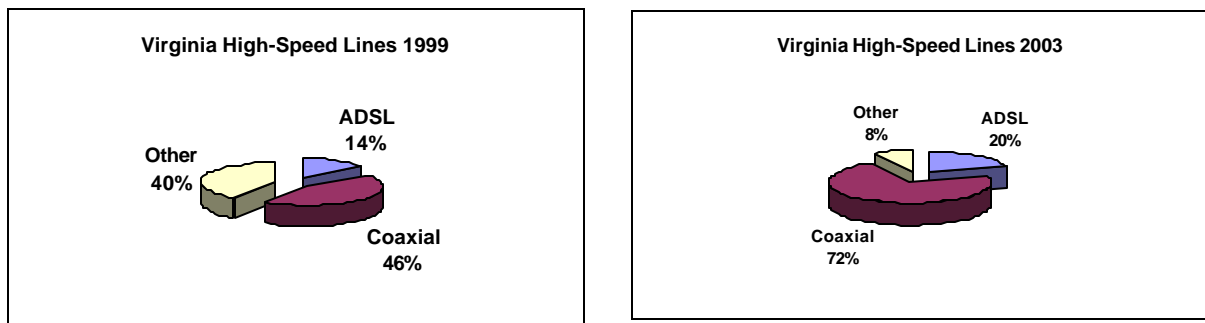
High-speed lines – lines that deliver services at speeds exceeding 200 kilobits per second (kbps) in *at least one direction*.

Advanced service lines – lines that provide services at speeds exceeding 200 kbps in *both directions*.

Lines that are not high speed are not reported.

According to the latest FCC data, the total (reported) number of high-speed lines connecting homes and businesses to the Internet increased by 20% during the second half of 2003, from 23.5 million to 28.2 million lines (or wireless channels). Of the 28.2 million, 20.3 million provided advanced services, which represents an increase of 25%. During this period, the technology showing the greatest high-speed line increase was asymmetric digital subscriber line (ADSL), which increased 24% from 7.7 million to 9.5 million lines. Second was coaxial cable (cable modem) with an increase of 20%. The remaining 2.3 million high-speed connections are accounted for by wireline technologies other than ADSL, wireless, satellite and fiber high-speed connections.

From 1999 to 2003, the number of high-speed lines in Virginia rose from 51,305 to 716,839. The following charts show a breakdown of Virginia's high-speed lines by technology for 1999 and 2003, respectively:



To highlight the importance that the Incumbent Local Exchange Carriers (“Baby Bells”) are placing on the deployment of broadband services, consider what two major carriers in Virginia are doing. Since the release of the Commonwealth’s 2002 broadband report, Verizon has almost tripled the number of DSL-equipped central office sites deployed in Virginia. In 2004, Verizon has 317 sites while in 2002 it had 108. Verizon also has equipped more than 500 remote sites, bringing the number of DSL-equipped Verizon sites to 861. During that same time frame, Ntelos of Waynesboro has equipped more than 25 sites for DSL and has launched a portable broadband solution that allows users to access broadband-level connectivity without being tethered to a phone/cable connection or wireless hot spot.

While these developments have placed Virginia in a positive position with regard to the number of high-speed lines that have been deployed, it is important to continue to measure the competition at local, national and global levels. Using the FCC data as the benchmark, Virginia compares to its neighbors as follows:

High-Speed Lines by State (over 200 kbps in one direction)					
State	Dec-99	Dec-00	Dec-01	Dec-02	Dec-03
North Carolina	57,881	136,703	357,906	594,039	842,130
Virginia	51,305	139,915	292,772	463,455	716,839
Maryland	52,749	124,465	260,634	391,397	578,004
Tennessee	66,307	122,391	237,401	369,370	471,341

Measuring infrastructure deployments is a widely accepted methodology for benchmarking progress toward bridging the Digital Divide. While this method does provide a measure of the physical aspect of broadband deployment, it focuses attention on the construction of the network rather than the development of applications and transactions that create the real economic and social benefits that result from online user engagement and interaction. It is important to note that sometime in the near term, Virginia will have to lessen its fixation with having the greatest number of lines and follow the European Community's lead toward a strategy focused more on being a leader in the development of high-end, high-quality applications.

These rankings represent many years of effort and investment, but there are still many miles to go if Virginia is to reach the premier slot in each of these studies. Maintaining status quo is not an option.

Regardless of where the Commonwealth ranks today, it must continue its commitment to provide individuals, businesses and governments with affordable access to cost-effective broadband technologies. As part of this commitment, the Commonwealth must focus not only on promoting the deployment of infrastructure but also on initiating and supporting the development and use of applications that push the limits of technology and create a need for broadband capacity.

BROADBAND INITIATIVES IN VIRGINIA

Virginia has proven time and again that it is not willing to accept the status quo and allow private sector interest and activities to determine its future. Rather, the Commonwealth is known for taking ownership of its destiny and setting in motion an aggressive course of action to insure success. Broadband is no exception. Rather than wait for the private sector to catch-up to their needs, Virginia universities, towns, counties and municipalities are leading the charge to ensure that their connectivity needs are met now.

UNIVERSITY INITIATIVES

In September 2004 the Southern Governors Association (SGA) endorsed the *Resolution Regarding a Southern States High Performance Super Computer Network Grid* introduced by Governor Mark R. Warner.

The Network Grid resolution sets forth the Association's commitment to the Southeastern Universities Research Association's (SURA) proposal to develop creative public-private partnerships with state governments, its higher education community and well-positioned corporate partners to gain access to and potential ownership of high-performance networking assets, thereby creating a high-performance network grid. The items delineated in the resolution reinforce the SGA's commitment to aligning state government and higher education to strengthen the science capacity and economic competitiveness of the South (a.k.a SGA's eCorridors Project). The resolution further resolves that the staff of the SGA and SURA work together to ensure the compatibility of the high-performance computing and networking technologies of the higher education community and state governments and to ensuring that the Southern States¹⁹ have the broadband capacity necessary to improve the science capacity and economic competitiveness of the region.

National Research Network Initiatives

National Lambda Rail (NLR)

NLR is a program initiated by U.S. research institutions to create a national optical research network capable of meeting the most advanced research requirements projected for the next five to ten years. The NLR boasts a strong alliance of partner entities including gigaPOPs, supercomputing facilities, federal research labs and private sector stakeholders. NLR is an incorporated entity, with each partner participating in its management and development. One key application of the NLR is to connect new sites to the TeraGrid.

To fund NLR, \$5 million each has been committed from Duke University, Georgia Tech, the Virginia Tech Foundation, Mid-Atlantic Terascale Partnership, the Big 10 Universities, consortia of universities and



¹⁹ Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, Missouri, North Carolina, Oklahoma, Puerto Rico, South Carolina, Tennessee, Texas, U.S. Virgin Islands, and West Virginia

research entities in the California, Florida, and the Seattle areas, plus the national Internet2 Consortium. Virginia Tech was invited to participate and encourage the formation of a consortium of universities and research entities in the mid-Atlantic region. The node planned for the Washington, D.C., area will provide connections to Atlanta, Raleigh, Chicago, Denver, Pittsburgh, Seattle, San Francisco and San Diego.

TeraGrid (a.k.a. the Distributed and Extensible Terascale Facilities Project)

Launched in 2001 with \$53 million from the National Science Foundation, the TeraGrid is a multi-year set of initiatives to develop and deploy the world's largest, fastest distributed computing infrastructure for open scientific research. The TeraGrid links supercomputers, massive data archives and databases, visualization devices and displays, and research instruments with grid computing software over a dedicated high-speed network. Initially, the TeraGrid connected four advanced computing research sites: Cal Tech; University of California, San Diego; Argonne National Laboratory; and the University of Illinois, Champaign-Urbana. In 2002, the network was expanded to include the Pittsburgh Supercomputer Center operated by Carnegie Mellon University and the University of Pittsburgh. The latest additions to the network are located in Austin, Texas and Atlanta.

Virginia Research Network Initiative

In order to remain competitive, Virginia Universities must be equipped to participate in national research activities. Currently, the telecommunications infrastructure in Virginia does not provide the level of optical networking that is required for participation.

Not willing to sacrifice academic opportunity, Virginia universities have joined forces with universities in Maryland and Washington D.C. to create the Mid-Atlantic Terascale Partnership (MATP)²⁰ to sponsor the location of a National Lambda Rail (NLR) node in the Washington D.C. area (McLean)²¹, facilitate access to the network node, and strengthen collaboration for combining resources and application support. MATP is open to any public or private research institution in Virginia, Maryland or Washington D.C.

The MATP will function to ensure Virginia (and the mid-Atlantic region as a whole) achieves a significant role in national initiatives such as the NLR, the Extensible Terascale Facility and the National Science Foundation's Cyberinfrastructure program²².

²⁰ The Mid-Atlantic Terascale Partnership (MATP) is a consortium of research institutions in Virginia, Maryland, and Washington formed to support research activities that require next-generation high-performance network connectivity. MATP founding members include: Virginia Tech, The University of Virginia, Old Dominion University, Virginia Commonwealth University, George Mason University, and the College of William and Mary. Each MATP participant will share a portion of the cost of the \$5 million commitment made by the VA-Tech Foundation to ensure the location of the NLR node.

²¹ The NLR node is currently in place and expected to be operational in early 2005.

²² Both the cyberinfrastructure program and the extensible terascale facility are national research optical network initiatives that are backed by substantial funding. Thus far, Virginia has not received any funding from either of these programs.

To demonstrate the Commonwealth's commitment to research and academic excellence, at the end of the 2004 General Assembly Session, Governor Warner provided \$2.4 million (total) to Virginia universities participating in MATP to help defray the cost of hardware and connections necessary to link to the NLR node. Negotiations for optical network services to connect the individual universities to the network are under way.

COMMUNITY INITIATIVES

Rural communities across the Commonwealth are taking bold steps to ensure inclusion in the global economy through broadband deployment. While states grapple with how to traverse the last mile, countries such as Scotland, Korea and Italy are raising the competitive bar by making available advanced broadband networks to citizens. Additionally, these nations are leading the charge in the development of advanced applications that require the use of broadband.

Fortunately, many communities in Virginia have recognized that time is of the essence in broadband deployment. Across the Commonwealth, deployments are occurring at all community levels. Regional partnerships, planning districts, counties and even individual towns are pursuing affordable broadband connectivity as a means of bringing urban parity to their rural communities.

Currently, there are three major open-access fiber network initiatives underway in Virginia. In Southwest, LENOWISCO and Cumberland Plateau Planning Districts have made progress with their initiatives. In Southside, the Mid-Atlantic Broadband Cooperative has begun building a huge business-class network. Once completed, these three networks alone will provide a competitive landscape for last-mile service provision in more than 25 of Virginia's rural counties. The possibility of an additional open-access fiber network in the New River Valley Region, if brought to fruition, will add an additional four counties to this total.

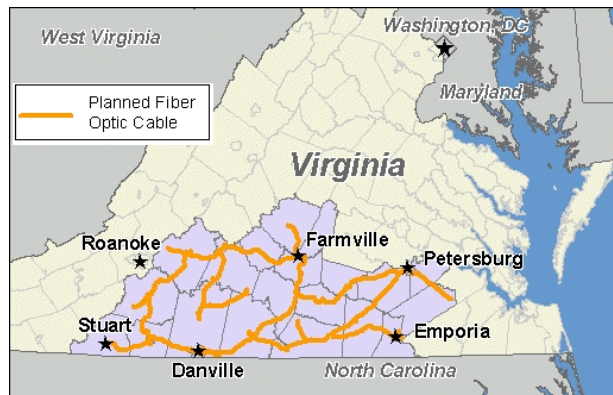
In addition to fiber backbone, communities are beginning to implement alternative solutions such as wireless (licensed and unlicensed) and broadband over power line to solve their needs. The remainder of this section details some of the broadband deployment activities currently under way in the Commonwealth.

Mid-Atlantic Broadband Cooperative

The Mid-Atlantic Broadband Cooperative (MBC) is a non-profit 501c(6) cooperative organized under the laws of the Commonwealth of Virginia. The MBC is composed of an interim General Manager, and an initial 10-member Board of Directors consisting of representatives from Southside and Southwest Virginia.

With \$6 million from the Virginia Tobacco Commission, MBC is overseeing the construction and operation of an advanced fiber-optic backbone project—the Regional Backbone Initiative—to connect all 56 industrial parks in Southside Virginia, carrier central office locations, hospitals, higher educational facilities and other connectivity

points. Once completed, the network will cover more than 700 miles across 20 counties and five cities as shown on the map below²³.



The projected user base includes almost 700,000 citizens and 19,000 businesses. The federal Economic Development Administration is co-funding the project with a matching contribution of \$6 million. The MBC will offer wholesale dark-fiber pairs as well as wholesale managed services to competitive carriers, existing carriers, cable companies, content service providers and research groups.

In February 2004, MBC signed a contract with the Adesta Group, a large telecommunications services company that plans, designs, constructs and manages large fiber-optic projects. Adesta is managing the design and construction for approximately 400 miles of the fiber-optic network. As part of this project, Adesta is building a new, state-of-the-art Network Operations and Control Center (NOCC) in South Boston that will be used to manage the operational aspects of the MBC network as well as control other networks that Adesta manages in the region. As a true partner, Adesta is investing its own money in the set-up of the NOCC. This center will create at least 20 new highly paying jobs in this Virginia town.

The RBI will provide for connections outside the Southside region, including Roanoke, Richmond, Norfolk, Tysons Corner and Raleigh, North Carolina. These connections will provide open-access connectivity to major telecom hub locations and allow the Southside region to market itself as a new home for technology-related industries, connectivity and job creation.²⁴

MBC has engaged the services of Dewberry & Davis, a large engineering firm with offices in Danville. Dewberry is designing approximately 290 miles of the fiber-optic route and is managing the EDA-funded portion of this project.

According to estimates from EDA, the projected economic benefits from the MBC project include 1,560 new jobs, \$70.2 million in new wages and \$143 million in new investment for the Southside region.

Network Danville

The City of Danville is constructing Network Danville (nDanville), a sophisticated fiber-optic broadband network over which digital data, voice and video signals can be

²³ Reference Map obtained from www.mbc-rbi.org

²⁴ Additional information on the MBC initiative can be obtained by contacting Tad Deriso, Interim General Manager, 804-786-7692

transmitted point-to-point in Danville at very high speeds²⁵ as well as to and from worldwide locations via the Internet. The network is being built in phases with help from World Wide Packets, a Spokane, Wash. company specializing in municipal networks.

Plans call for nDanville to be rolled out in three phases:

1. Internet access for municipal offices and local schools.
2. Voice and data services for businesses.
3. Bundled consumer services including voice, data and video.

The expected cost for the complete deployment is \$37.5 million.

nDanville is anchored at the eDan Multimedia Service Access Point (MSAP) located at the Galileo Magnet High School. nDanville connects from this location to MCI's top-tier national Internet backbone. Eventually, fiber-optic cables will radiate from the MSAP to schools, municipal buildings and facilities, and utility infrastructure components at approximately 100 locations over a 70-mile route. nDanville will share cabling with the Future of the Piedmont's eDan to the north, and with the Mid-Atlantic Broadband Cooperative's RBI to the east and west.

Currently (at the end of Phase I), nDanville serves only the municipal government and public school system. The city and schools use nDanville to improve multimedia communications and data transmission, support shared use of computer applications and data files, enable videoconferencing and distance learning, expand Internet access, monitor and control equipment, and improve the reliability of utilities and traffic control systems. The \$2.5 million funding for this phase of the project came from Danville's municipal electric utility reserves.

Future phases of nDanville will provide for increased service efficiency and effectiveness to the benefit of citizens and utility customers and expand educational opportunities for Danville's students. Additionally, a limited number of pilot projects will be undertaken during the initial installation to demonstrate the potential application of nDanville's technical capabilities for broader commercial use. Funding for these phases has yet to be set.

Lee, Norton, Wise & Scott (LENOWISCO) Planning District

The LENOWISCO Planning District is leading the charge for extending world-class broadband services to residents in rural Southwest Virginia. Through the LENOWISCO Rural Area Network project, the Planning District is proposing to put the world's most advanced communications infrastructure within reach of every business and citizen in the LENOWISCO area within 10 years. The overriding goal of the program is to provide extremely high-speed, reliable broadband network infrastructure at a fraction of currently available prices to act as a catalyst to create substantial economic, educational and health care enhancements for citizens and to create a distinct competitive advantage for its

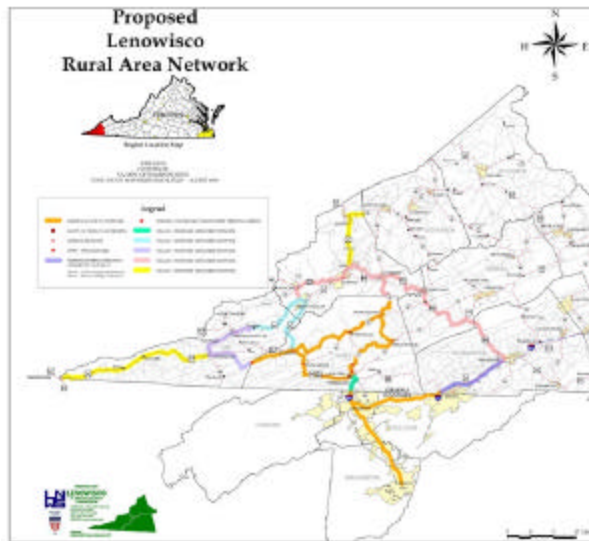
²⁵ nDanville is a business class fiber optic network offering speeds up to one gigabit in both directions (more than 1,000 times faster than typical DSL).

businesses (current and future). This infrastructure will be private sector based as a means of ensuring its sustainability and economic viability, and it will enable the emergence of a communications and network industry in southwest Virginia. This new industry, still in its infancy, combines leading-edge optical technologies with very high capacity wireless networks and advanced features of the Internet Protocol to enable an extraordinary advantage in cost and communications power.

The first phase of the LENOWISCO Rural Area Network – from Duffield to Big Stone Gap – involves the installation of fiber optic conduit alongside a public water system. Once the system is complete, it will be made available to nearby colleges, businesses and eventually, households. The project is providing “a model for cities and rural areas on how to deploy future-proof community networks that will deliver all the services residents and businesses require, now and in the future. It is the kind of network that will allow communities to attract businesses, assist in establishing cottage industries and enhance the quality of life citizens expect as well.”²⁶

To date, 69 miles of fiber have been installed with both underground conduit and conventional overhead construction techniques being utilized.

Connectivity is in place between Duffield in Scott County and Big Stone Gap with additional construction ongoing from this circuit to Norton and Wise in Wise County. An additional line is operational between Duffield and the Lee County communities of Jonesville, Pennington Gap and Stone Creek.



Preliminary estimates for the completion of the entire network are in the \$6 million range. Primary funding for the network has come from local resources and the Virginia Tobacco Commission. Since 2002, the Virginia Tobacco Commission has contributed in excess of \$2.5 million to the project. Additional last mile planning and project funding in the amount of \$61,668 has been provided by CIT.

The Virginia Coalfield Economic Development Authority recently awarded a \$75,000 grant to the Wise County Industrial Development

Authority for LENOWISCO, Inc. to provide last-mile funding for a redundant fiber-optic link between downtown Norton and the Esserville Industrial Park to support an expanded and new employer that requires high-speed broadband for business processes.

²⁶ Quote from Skip Skinner, LENOWISCO Broadband Project Manager

Currently in the planning stages is a funding application to the EDA for \$3 million in federal funds that must be matched by a like amount for LENOWISCO and Cumberland Plateau to provide connectivity to key economic development locations in their respective districts.

CIT is investigating the Department of Agriculture's Distance Learning and Telemedicine program as a strategy to assist in building out the LENOWISCO network.

Dickenson County

Dickenson County Wireless Integrated Network (DCWIN) blankets approximately 200 square miles of Dickenson County and parts of Wise and Buchanan Counties with wireless broadband telecommunication services. In addition to supporting Dickenson County's municipal and e-911 communication systems, DCWIN provides fast, affordable broadband services to business and residential customers²⁷ throughout the coverage area.

In 2003, Dickenson became the first county in Virginia to begin installing a completely wireless (backbone and last-mile) countywide network. Five towers and \$600,000 later, Dickenson County now operates a model rural network that supports more than 100 customers. Recognizing the success of DCWIN and its leadership role in the deployment of rural wireless broadband connectivity, CIT became DCWIN's first "outside" investor by contributing \$25,000 toward additional tower construction.

In addition to physically deploying and operating a wireless network, DCWIN has mentored other Virginia communities through the complex decision-making process associated with the design and deployment of wireless projects. The DCWIN staff has assisted numerous counties, towns and even private individuals working with municipalities on wireless network projects. During the past few months, at the request of CIT, DCWIN has shared its expertise with the Northern Neck-Chesapeake Bay Regional Partnership's NeckTech Initiative. By partnering with experts on the DCWIN staff, the NeckTech committee has a marketing study and proposed network design that will allow them to forge the relationships necessary to provision affordable wireless broadband across their region.

DCWIN is proving that wireless technology offers an affordable and reliable alternative to fiber for both last-mile and backbone applications. The project shows that affordable broadband can be delivered in the most rugged of terrains, where not only the topology, but also the demographics have historically daunted commercial providers. Dickenson County may be the youngest county in Virginia, but the existence of DCWIN is a testament to its maturity beyond its years in the field of broadband deployment.

Broadband Over Powerline

As a part of its goal to promote access to broadband services to all Americans and to encourage the development of new technologies, the FCC in October 2004 adopted changes to Part 15 of its rules to encourage the development of Access Broadband over

²⁷ DCWIN rates are as follows: \$39.95 for residential (1540 kb/sec), \$69.95 for SOHO (1540 kb/sec, 5 networked computers, one static IP address), and \$399.95 for commercial grade connectivity (3080 kb/sec).

Power Line (Access BPL)²⁸. Specifically, the Order by the Commission sets forth specific technical and administrative requirements for Access BPL equipment and operators to ensure that interference (with licensed radio service operations) does not occur and, should it occur, to provide for a timely resolution without disruption of service to Access BPL subscribers. Such a move on the part of the FCC legitimizes the existence of BPL and recognizes the potential impact that such a pervasive system could have on shaping the future of broadband connectivity. Virginia has three active BPL deployments in Manassas, Salem and Central Virginia.

Manassas

In 2003, Virginia became “home” to the first large-scale commercial broadband over power lines (BPL)²⁹ deployment in the City of Manassas.

Manassas initially partnered with Prospect Street Broadband, a Delaware company, to conduct a beta test of BPL technology using equipment supplied by Main.net of Reston [see sidebar, this page]. The project was a success, and the partnership evolved into a 10-year franchise agreement for Prospect Street Broadband to provide a complete suite of BPL services to the city. Under this agreement, Prospect Street acts as the provider, owner and operator of the high-speed Internet access networks. Available services include: technology selection, purchase, ownership, monitoring, maintenance, replacement and upgrade; network operations, customer care, technical support, troubleshooting, automated billing and related services; and all content. Future plans include a full suite of “smart home” and utility network management applications.

How Manassas’ BPL Works

Utilizing state-of-the-art PLUSTM technology, Main.net provides high-speed Internet access to every ordinary electric wall socket. No special wiring is required. Customers simply plug a modem into any electric outlet and access the Internet. PLUS uses a sophisticated modem technology to achieve high data rates over noisy low-voltage power lines.

Currently, BPL customers pay \$26.95 per month with no installation fees and no long-term contracts. In contrast, cable modem service in Manassas can be as much as \$55 per month (without a bundled package that includes cable television service), and DSL averages approximately \$30 per month. Both cable and DSL charge installation fees and require long-term contracts.

As of August 2004, the BPL network supported more than 200 users with an additional 1,200 potential users on a waiting list. The system is expected to blanket Manassas with coverage by early 2005.

²⁸ BPL technology accommodates the delivery of broadband level communication services to across existing electrical power plant/equipment.

²⁹ BPL is also known as Power Line Communications (PLC)

Salem

The City of Salem is a business-driven community focused on improving the services of a growing region by embracing technology advancements typically found in larger metropolitan cities. The latest technology under evaluation by the city is Amperion's POWERWiFi™, a hybrid solution that combines BPL with wireless Wi-Fi technology [see sidebar, this page].

This solution has the potential to convert the entire City of Salem into a wireless broadband community by supplying subscribing businesses and homes with access to high-speed Internet connections boasting data rates up to 24 mbps.

Working with Roanoke College and the City of Salem Electric Department, Salem-based provider Designed Telecommunications (D-Tel), has deployed a BPL network in the heart of Salem. This initiative makes Salem one of the first municipalities in the nation to provide broadband Internet services to businesses and residential subscribers by deploying BPL on the city's existing power grid.

The City of Salem Electric Crews installed the initial network in less than four hours after being trained by D-Tel's staff. D-Tel's engineering and project management staff supervised the network installation.

How Salem's BPL Works

This unique solution integrates BPL with standard Wi-Fi technology over the City of Salem's medium-voltage power lines. The technology transmits broadband Internet signals onto the power grid using BPL equipment that is installed on the power lines. The equipment also has an antenna attached whereby any subscriber to the service can access the Internet using standard Wi-Fi equipment. Unlike DSL or cable modem services, POWERWiFi™, also provides the ability for subscribers with Wi-Fi equipped laptops to have the freedom to maintain connectivity while roaming anywhere in the coverage area.

Central Virginia Electric Cooperative

In 2004, the Central Virginia Electric Cooperative (CVEC) in Lovingson announced that it was teaming with International Broadband Electric Communications of Huntsville, Alabama to begin delivering affordable broadband Internet services to its customers. CVEC is the first cooperative in the United States to host a rural commercial deployment of BPL, with more than 50 miles of rural distribution line serving the initial 50 BPL pilot subscribers in central Virginia. The expanded market pilot program (currently under way) will deliver BPL services to more than 4,000 homes and businesses.

Consumers need only purchase a \$99 adapter to connect to the system. Residential connectivity costs \$29.95 per month for a 256 kbps connection.

If the pilot continues to be successful (technically and financially), the Cooperative plans to extend the service throughout its territory until all of its 30 substations in 14 central Virginia counties³⁰ are online. In addition to extended reach, future plans for the network include the incorporation of next-generation equipment in 2005, with complete system build out scheduled for 2005-2006.

VIRGINIA'S BROADBAND RESOURCES

Virginia's Center for Innovative Technology

In 1999, Virginia's Center for Innovative Technology (CIT) launched a formal program to promote the awareness and use of electronic commerce techniques and technologies. Known as e-Business Outreach, the program assists small and medium-sized traditional businesses and local governments in rural areas who needed additional coaching in order to capitalize on the power of the Internet. In 2002, the Outreach program was expanded to provide assistance to those companies and localities interested in obtaining broadband services.

During the 2002 General Assembly session, CIT was assigned responsibility for delivering a study on advancing affordable, high-bandwidth electronic networks in rural Virginia (HJ163). The study was delivered to the General Assembly on November 30, 2002. As a result, CIT's mission was expanded in the 2003 session (by budget amendment) to include "supporting efforts of public and quasi-public bodies within the Commonwealth to enhance or facilitate the prompt availability of and access to advanced electronic communication services, commonly known as broadband, throughout the Commonwealth, monitoring trends and advances in advanced electronic communications technology to plan and forecast future needs for such technology, and identify funding options."

As a result, CIT is the only resource in the Commonwealth to offer assistance on both the "supply" and "demand" sides of the broadband equation. By facilitating developments on both sides of the equation, CIT is working to ensure that there is not only infrastructure but that there are also users to take advantage of the networks that are being built. This holistic approach to solving the Digital Divide sets Virginia apart from most state assistance programs that concentrate solely on the deployment of infrastructure.

CIT's philosophy is the result of hard work and the reality that the Commonwealth has not funded its broadband program to support large-scale investments in infrastructure. CIT also is committed to the idea that it is best not to overbuild networks wherever possible.

For FY2004, CIT's Broadband Program had \$250,000 in funding to provide assistance to communities across the Commonwealth with both supply and demand oriented activities. Through strategic partnering and leveraging federal investments being made in the Commonwealth for broadband planning and deployment, CIT was able to participate in

³⁰ CVEC serves locations in Augusta, Albemarle, Greene, Orange, Louisa, Goochland, Fluvanna, Cumberland, Buckingham, Appomatax, Prince Edward, Campbell, Amherst and Nelson Counties.

more than 15 broadband-related initiatives throughout the Commonwealth. Additionally, the same \$250,000 returned \$2.8 million in leveraged funding to the Commonwealth. Due to budget constraints, the program's FY2005 budget has been reduced to \$150,000.

Currently, CIT's Broadband Program is assisting communities across the state planning network deployments. From the Northern Neck to far Southwest Virginia, CIT is bringing expertise and resources to broadband projects in all stages of development. In Southside, Virginia, CIT is coordinating with the Planning District Commissions and Mid-Atlantic Broadband Cooperative to provide demand aggregation and e-commerce training services to the communities along the e-58 corridor. These activities are the result of a \$140,000 grant awarded to CIT by the federal Economic Development Administration to complement the infrastructure project that is under way.

In addition to one-to-one services, CIT regularly provides topical information as well as opportunities for funding, contracting, and/or partnerships through its e-mail-based Broadband Information Group.

To expand the services of its broadband program beyond the consulting/expertise provided by CIT staff, two primary outreach mechanisms are in place to provide extended educational opportunities and technical assistance. These two programs are the e-Business Villages and Electronic Commerce Forums.

e-Business Villages

e-Business Villages (EBV) are the e-commerce assistance arm of CIT's Broadband Demand Development program and its primary vehicle for generating broadband demand. Through this program, small businesses, local governments, and regional economic development agencies can experiment with electronic commerce techniques and technologies in a vendor-neutral, education-oriented environment.³¹ Regionally oriented, the villages themselves are "virtual" entities. The Virginia Electronic Commerce Technology Center (VECTEC) in Newport News, Va., and VECTEC-West in Lebanon, Va.,³² provide technical support for this program.

Electronic Commerce Forums

Electronic Commerce Forums (EC forums) are regionally based, vendor-neutral educational groups that encourage and support electronic commerce and broadband awareness, education, and commitment across Virginia. The forums also encourage the cultivation of e-relationships among Virginia businesses by providing a venue through which companies interested in e-commerce can become acquainted. Topics that have been successfully presented in the forums include: Security, Cyber-Law, Search Engine Positioning, Broadband 101 and Customer Service.

³¹ Services include (but are not limited to) web site design and development, back-office automation, graphic design, search engine optimization, catalog and shopping cart design and implementation.

³² In Southwest Virginia, VECTEC-West has partnered with Southwest Virginia Community College and Mountain Empire Community College to serve as the local service points for the two EBV's in the region.

Virginia Electronic Commerce Technology Center

The Virginia Electronic Commerce Technology Center (VECTEC), a non-profit e-commerce center, established in 1994 at Christopher Newport University, helps small to medium size businesses, nonprofit organizations, local governments and regional agencies throughout Virginia with a variety of e-commerce services including Web site design, shopping systems and custom database development, search engine optimization, business research and educational programs.

Education is central to the mission of VECTEC. VECTEC strives to help businesses become more educated consumers through one-on-one sessions with the staff. The program is similar to an incubator program. It teaches businesses what they need to know about creating an online presence and then encourages them to acquire services through the private sector. More than 60 companies have graduated from the program to date.

VECTEC is currently working with more than 170 companies, state, and local governments and regional agencies throughout Virginia. Of these 170 organizations, more than 90 are located in the Hampton Roads region, 63 are in Southwestern Virginia³³ and the rest are located in other areas of the Commonwealth.

Since its inception in 1994, VECTEC has been funded (in part) by CIT³⁴ to provide e-commerce training and education to companies and communities as an integral part of the broadband demand development activities. Due to budget constraints, the level of funding provided from the Commonwealth (including CIT) has dwindled, while the center's importance to the broadband demand generation activities has increased. As a result, fewer areas receiving broadband assistance from CIT are being offered e-commerce services necessary to build a solid user base among traditional companies.

Virginia Tech e-Corridors

The mission of the e-Corridors' group is to create competitive advantage by facilitating the deployment of advanced network infrastructure and applications leveraging inter-regional connectivity for communities. Having extensive experience in research and development of state-of-the-art network infrastructure, Virginia Tech (through its e-Corridors program) assists communities by serving as a facilitator and catalyst for the development of creative partnerships with municipalities, public utilities, non-profit entities and private sector companies to combine resources and expertise for the deployment of advanced, broadband network infrastructure and services made up of next-generation technologies.

In 2003, Virginia Tech's e-Corridors group released the results of a series of studies on issues surrounding the investment and development of strategic telecommunications infrastructure for communities. The studies used Southside and Southwestern Virginia in

³³ VECTEC officially established a field office in April 2002, in Lebanon, Virginia. VECTEC "West" provides e-commerce support to rural communities in Southwest Virginia.

³⁴ The remainder of VECTEC's funding has historically been generated through project fees, General Assembly appropriations to Christopher Newport University (ended in 2004), and grant opportunities.

a Geodesic Mesh network design and viable financial model that can be replicated in any region of the United States. The overall premise of the studies is that investment in advanced next-generation telecommunications infrastructure is an essential and achievable component of a region's economic development and quality of life.

The 11-volume series entitled "Strategic Technology Infrastructure for Regional Competitiveness in the Network Economy" is available through the eCorridors Web site.³⁵

VIRGINIA'S BROADBAND STRATEGY

During the past five years, Virginia has taken bold steps to insure that the backbone telecommunications infrastructure necessary to support the delivery of affordable last-mile broadband services is deployed. "One Virginia" became the broadband rallying cry for communities in underserved regions.

We have made progress toward our goal of ubiquitous affordable broadband availability, but the journey is not complete. While metropolitan areas with high population concentrations such as Arlington, Fairfax, Prince William, Newport News and Richmond are flush with broadband service choices, areas with lesser concentrations such as Westmoreland, Page and Giles Counties are still operating on dial-up. Due to the rapidly changing broadband deployment landscape, it is impossible to estimate exactly how many Virginians are without affordable broadband access. But so long as a dichotomy exists, there is still work to be done.

The Virginia Tobacco Commission and the Appalachian Regional Commission actively support broadband deployment in the Southside, Southwest and western Shenandoah areas in Virginia. Thanks to these initiatives, the Southside and Southwest Regions of Virginia are well on the way to having a strong, open-access broadband environment in which local services providers can compete and flourish. But questions still remain: How does the service reach the consumer? What resources are available to communities that don't qualify for support from the Appalachian Regional Commission and Virginia Tobacco Commission?

The answers to these two questions plague many communities today. Without sufficient funding for last-mile access and training for localities and businesses in the use of electronic commerce and broadband technologies, the vision of "One Virginia" will not be realized. Without adequate funding, underserved communities will remain that way.

This year, CIT will continue to seek funding dedicated to the expansion of its Broadband Outreach program. It is anticipated that \$500,000 of funding, divided between CIT and VECTEC, would allow CIT to provide more robust funding opportunities and offer more hands-on assistance to communities in need. Proposed activities include:

³⁵ <http://www.ecorridors.vt.edu/research/papers/?id=22>

- Establishing a broadband fund to provide match, planning and/or limited last-mile infrastructure assistance to underserved communities.
- Expanding the outreach mechanism to improve access to broadband and application-oriented training.
- Deploying additional technical resources to assist communities with broadband strategy development and demand aggregation.
- Developing an application-oriented vision that focuses Virginia's definition of broadband success on the use of broadband technologies rather than having the most high-speed lines in place.
- Providing e-commerce training through enhanced VECTEC activities.

With additional support to CIT's broadband program, the Commonwealth can accelerate the rate that the "One Virginia" vision is realized. Without this additional funding, those areas covered by external funding mechanisms such as the Virginia Tobacco Commission will continue to push forward, while other areas will fall farther behind essentially creating another Digital Divide within the Commonwealth.

IV. RETURN ON INNOVATION

INTRODUCTION

Technological advances are the foundation for improvements to our quality of life and provide significant economic opportunity for the citizens of the Commonwealth. On their own merit, advances in technology will permeate the Commonwealth's business communities over time. However, in order for Virginia to exert a leadership position in innovation, technology production and technology acceptance, the natural process must be accelerated.

Acceleration ensures that the Commonwealth will secure new economic engines to replace declining industries like tobacco and manufacturing. By understanding the cycles of research, innovation, commercialization and new industry generation, the Commonwealth can improve the creation and survival rate of new industry development. New industry development creates new employment opportunities and generates tax revenues. Virginia is committed to the development of its high-tech industries and has invested in the Innovative Technology Authority to serve as the Commonwealth's accelerator for technology-based economic development.

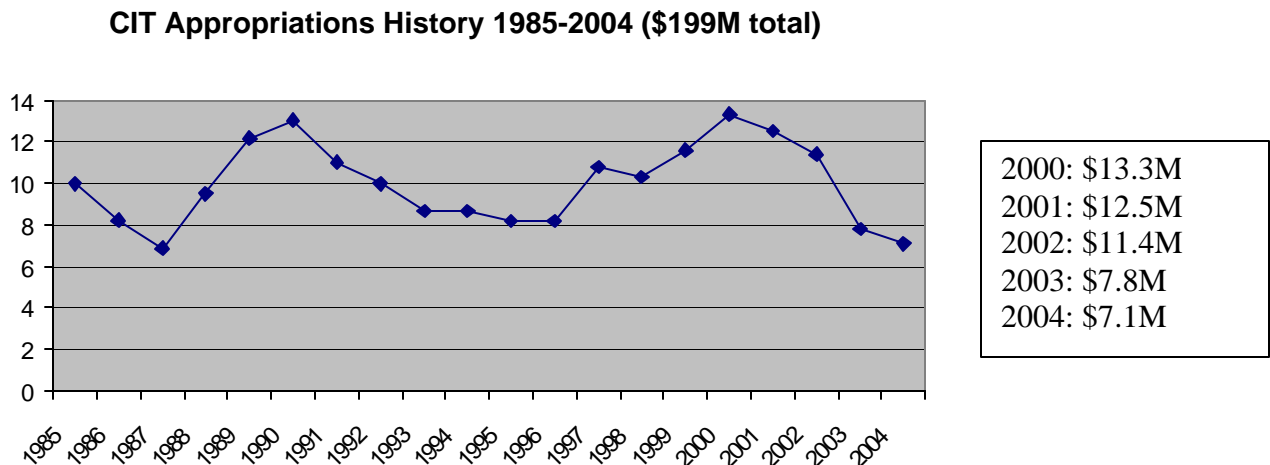
Virginia's General Assembly established the Innovative Technology Authority based on recommendations from the 1983 Governor's Task Force on Science and Technology. Virginia's Center for Innovative Technology (CIT), the private, non-profit corporation that serves as the operating arm of the ITA, was formally incorporated July 1, 1984.

In declaring CIT's public purpose and its use of public funds, the General Assembly charges CIT with pivotal roles in policy and performance to advance the Commonwealth's technology economy. CIT reports to an independent Board of Directors, to the Executive Branch through the Secretary of Technology, and to the Legislative Branch through the Finance and Appropriations Committees.

CIT's original mission was to promote economic growth by enhancing the ability of Virginia universities to develop and transfer technology to industry. CIT accomplished this mission primarily by co-sponsoring research projects with industry. From 1985-1992, CIT funded more than 600 projects involving more than 550 companies, 460 university professors and 1,000 students. From 1986 to 2002, CIT also invested \$28.2 million in 16 Virginia university research centers to attract leading researchers and work with companies in advanced, application-oriented research, and to develop and commercialize intellectual property.

FUNDING HISTORY

From 1985-2004, CIT received \$199 million in appropriations.



Source: Commonwealth of Virginia Appropriations bills

Of the total appropriations from 1985-2002, \$110.6 million or 60% was distributed throughout the state as awards and contracts to Virginia's colleges and universities for the foundation of technology-specific research centers and as co-sponsorship for industry projects conducted by university researchers. CIT's diversified portfolio of investments for the Commonwealth provides long-term gains in research prominence and promotes sustainable business growth through advances in technology. The following are just two examples of the way this investment has paid off for the Commonwealth:

- The Center for Power Electronics Systems (CPES), established by CIT in 1988 at Virginia Tech, is now a National Science Foundation Engineering Research Center. CIT's funding of \$3 million for CPES has resulted in the creation of 762 jobs and \$51.7 million in increased competitiveness for Virginia companies.
- The Internet Technology Innovation Center, established by CIT in 1998 as a partnership among Christopher Newport University, George Mason University, the University of Virginia and Virginia Tech, aims to elevate the quality of life in Virginia through research, development, commercialization and distribution of Internet-related technologies, products and services. CIT's \$1.2 million funding over three years has resulted in federal and private leverage of \$29 million.

PERFORMANCE MEASUREMENT

CIT began to study and report the economic impacts of its programs in 1995. The first report covered the period of 1988-1995. Subsequent studies have been conducted annually. From 1998-2004, CIT clients credit CIT's assistance in creating more than

30,000 jobs, attracting \$282 million in federal funding, and increasing competitiveness of \$3 billion. The return on the state's investment in the competitiveness figure alone is greater than 15 to 1.

From CIT's inception, there was an expectation that it would draw an increasing proportion of its funding from sources other than its General Fund appropriation. Until 2001, CIT's programs and services focused on those federal and private funding opportunities that provided direct revenue to its university and business clients. Reductions in CIT's appropriation beginning in 2001 forced a re-examination of CIT's priorities, and a search for funding sources that would support CIT's outreach to the Commonwealth's researchers and technology industry.

Continued belt-tightening in the Commonwealth in 2002 resulted in a 60% decrease in CIT's funding from FY2002 to FY2004. Recognizing that finite resources requires a focused set of targets, CIT restructured its operations in 2004, and it responded to a renewed challenge posed by the Warner Administration and Virginia's General Assembly to find alternate sources of revenue for its activities.

CIT's current leadership team has taken the most dramatic steps in the enterprise's history to diversify its funding sources. Pursuit of federal contracts for CIT programs, as well as for universities and businesses in Virginia, has contributed \$8 million to CIT's revenue in the past three years.

However, budget language that desired CIT to achieve complete self-sufficiency by FY2008 required a business plan that would initiate a fundamental change in the way CIT operates. Presentation of this plan to the Administration and members of the General Assembly brought recognition that gradual removal of all state funding would ultimately change CIT's mission, shifting focus away from Commonwealth-centered activities and toward federal contracts that are revenue generating and cost recoverable.

Instead, CIT's FY2004 and FY2005 operating plans have continued to pursue external revenue sources that support its mission and provide economic benefit to the Commonwealth. For example, CIT operates a Procurement Technical Assistance Center with \$150,000 of funding from the Defense Logistics Agency. CIT's PTAC helps central Virginia small businesses sell their technology products and services to federal, state and local governments. CIT assists the federal government with the small business outreach effort, and Commonwealth businesses derive the economic impact.

Similarly, CIT's program management of federal R&D projects solve national and regional technological or economic challenges, but they also engage Virginia's colleges, universities and small technology businesses as partners and beneficiaries of increased federal funding.

At the conclusion of the 2004 General Assembly session, overwhelming support for CIT's multi-source funding model resulted in a renewal of the 2004 appropriation level

for FY2005 and affirmation of CIT's mission to accelerate Virginia's next generation of technology and technology companies.

In determining the requirements to fulfill this mission in FY2005, CIT recorded the following observations of the economic climate for new technology research and development, and new technology business formation:

- There is a significant void in angel and venture investment for seed-stage technology firms in Virginia.
- There has been no significant turnaround in the survival rate of Virginia technology startups.
- The increased need for technological solutions in defense and homeland security creates opportunities for Virginia's technology researchers and businesses, whose proximity to the federal government offers a competitive advantage.
- Virginia's ability to capitalize on emerging fields and industry drivers such as nanotechnology and life sciences requires identification and pursuit of specialized market segments.
- Access to affordable broadband is unevenly distributed in Virginia, slowing economic recovery for rural communities.
- Federal dollars play a substantial role in R&D funding for small businesses in Virginia, offering both a non-diluting source of capital as well as a validation for early-stage innovation.

CIT'S 2005 STRATEGIC GOALS

As the enterprise responsible for advancing the Commonwealth's technology-driven economy, CIT's FY2005 operating plan includes four goals:

1. Create new nanotechnology and life sciences industry clusters in Virginia.
2. Solve national and regional technological challenges through world-class R&D programs with Virginia partners.
3. Make Virginia a global leader in the development of entrepreneurial technology ventures.
4. Advance Virginia's technology commissions and policy initiatives.

In 2004 and 2005, CIT changed the way it measured economic impact, identifying three distinct categories for demonstrating return on the Commonwealth's investment:

Cash – Revenue for CIT from sources other than the General Fund.

Leveraged Cash – Revenue and investment for Commonwealth entities.

Economic Value – Wages and sales gains for Commonwealth entities, calculated both in terms of projected future return and realized current return.

In FY2005, CIT will leverage the Commonwealth's \$7.75 million appropriation with additional earned revenue of \$8.1 million, bringing CIT's total operating revenue to \$15.85 million.

The projected return on the Commonwealth's investment in FY2005 is \$119.4 million, greater than 15 times the General Fund appropriation. This return is distributed as follows:

Cash	\$7.9 million
Leveraged cash	\$25.5 million
Economic value	\$86.0 million

In FY2005, CIT reached its 20-year milestone as a national leader in technology-based economic development. The contributions of 20 years have built the foundations for many of Virginia's technology companies and research facilities. CIT's FY2005 operating plan continues the tradition of high-value return on the Commonwealth's investment.

FUTURE OPPORTUNITY

Twenty years ago, creation of the Innovative Technology Authority and CIT helped to define the Commonwealth as a leader in the advancement of technology-based economic development. Over the past twenty years, new economies in the Commonwealth have emerged, including information technologies, software technologies, telecommunications, modeling and simulation, sensors and sensor systems, biotechnologies and microelectronics. These new industries serve as the backbone for the Commonwealth's economy today.

While Virginia has invested in its future, other states and countries have moved to make the same investments, creating a highly competitive environment on a global scale. Additionally, new technologies like nanotechnology and advanced biotechnology are envisioned to create significant advances that will serve as disruptive forces for today's businesses and economies.

The current appropriation of \$7.75 million for the Innovative Technology Authority enables CIT to keep pace with advances in emerging technologies, stimulate entrepreneurial investment and provide service to emerging technology companies. Together, these initiatives have generated in excess of \$225 million of economic value for the Commonwealth in FY2004.

Continued funding of the Innovative Technology Authority provides the Commonwealth with the ability to secure federal funds for research and economic development, foster new company generation and ensure technologies like broadband are ubiquitous throughout the state. Funding levels greater than the current appropriation level allow the Authority to invest in the development of new industries, companies and research programs that will yield the next generation of the technology economy.

V. INFORMATION TECHNOLOGY REFORM

The Information Technology Reform initiative launched by Governor Mark R. Warner has been and will continue to be a major focus of the Secretary of Technology. Through the newly created Virginia Information Technologies Agency (VITA), the IT Reform effort is helping the Commonwealth leverage the best of today's high-tech products and services to deliver timely and cost-effective services to citizens.

HISTORY

Governor Mark R. Warner and the Virginia General Assembly launched Virginia's Information Technology Reform initiative in 2002. This effort significantly changes the structure of state government and promotes increased services to citizens.

Numerous studies on technology in the Commonwealth concluded that having a decentralized approach to IT design and deployment created the following problems:

- Uncoordinated IT operations.
- Significant duplication of systems.
- Multi-million dollar IT project failures.
- Lack of enterprise systems and IT security policies.

To address these problems, the 2003 General Assembly passed landmark legislation to consolidate the IT resources and personnel of 90 executive branch agencies and create VITA to serve as the central, shared service IT "utility" for the Commonwealth. Like running water and electricity, IT infrastructure – such as telephones and computers – is a "must-have" in every agency and is foundational to the effective operation of state government.

The creation of VITA has allowed agencies to exit the IT infrastructure business and focus on improved service delivery to their customers. A standards-based infrastructure with common platforms promotes interoperability and collaboration and allows seamless services within and across agencies.

While the IT Reform initiative is in the initial stages of completion, Virginia has enjoyed early successes in the areas of improved governance and oversight, centralized technology procurement, cost savings and avoidances, promotion of enterprise solutions and opportunities, value-add provided to customers and the Commonwealth, and external validation. Furthermore, the IT Reform effort positions Virginia to deliver citizen services more effectively over the next decade as government shifts from a transaction basis to a more citizen-centric, event-oriented basis.

STATUS

VITA opened its doors on July 1, 2003. VITA's responsibilities fall into three primary categories:

- Operating the IT infrastructure for 90 executive branch agencies.
- Governing IT investments for the Commonwealth.
- Procuring technology for VITA and on behalf of other public bodies.

Three agencies were abolished and consolidated into VITA. Also consolidated into VITA during an 18-month period were the independent IT infrastructure activities of 90 executive branch agencies.

VITA completed all agency transitions successfully, exceeding its January 1, 2005 deadline by more than a month. VITA maintained continuity of IT services throughout the transition, which was seamless for agencies and employees. VITA has established a central customer service center for helpdesk support and new service information. It has also increased computer security and legal compliance activities across the board.

VITA Scope Statistics

	7/1/2003	1/1/2005
Supported Organizations	11	90
Locations	4	1,497
PCs and Laptops	600+	60,000+
Servers	30+	3,000+
VITA Employees	368	1,286

Source: VITA

In 2005, VITA will focus on transforming itself by implementing a shared services model. This includes: integrating facilities, hardware and software; realigning and possible relocation of IT staff; deploying innovative technology solutions; and implementing significant cost-saving initiatives.

ACCOMPLISHMENTS

In its short existence, VITA has made the following accomplishments:

- Established the Information Technology Investment Board (ITIB), a supervisory board charged with the operations of VITA and oversight of executive branch IT investments.
- Appointed the Chief Information Officer of the Commonwealth. The ITIB hired Lemuel C. Stewart, Jr., under a five-year contract to provide a focal point for enterprise IT decision-making.
- Prioritized technology investments across the Commonwealth. The ITIB submitted the Recommended Technology Investment Priorities Report, including a ranked list of major IT projects and recommendations. This Governor and

General Assembly use this report to determine funding priorities for technology investments.

- Improved IT project oversight and management by establishing the Project Management Division within VITA. This division is responsible for strategic planning and portfolio management, enterprise program management and project oversight.
- Coordinated the IT strategic planning process across the Commonwealth.
- Developed a cost-effective Project Manager Development Program to provide information, resources and affordable training opportunities to more than 800 participants.

ECONOMIC OPPORTUNITY

VITA offers many opportunities for cost savings by acting as a central procurement source for IT-related goods and services. Since its formation, VITA has overhauled the Commonwealth's procurement practices by emphasizing value over price and has lowered costs by leveraging its buying power. VITA procurements are faster, simpler and less expensive than in the past.

VITA has implemented 11 cost savings initiatives and two cost-avoidance initiatives to date, resulting in the following projected savings:

Savings Report (in \$1,000s)

	FY04	FY05	FY06
Gross Savings	\$15,665	\$25,130	\$26,316
Cost Avoidance	875	995	615
Total	16,540	26,125	26,931

Source: VITA

VITA also has launched 15 "Quick Win" initiatives, the savings of which will be returned to agencies to offset the 5.52% administrative fee in FY2005, which is estimated at a total of \$6.7 million.

In another cost-saving move, VITA and the ITIB are initiating enterprise opportunities in partnership with agencies. Examples of current initiatives include:

- Learning Management System
- Statewide Alert Network

- Enterprise Geographic Information Systems
- Government-to-Government Enterprise Systems Interface
- E-mail Consolidation
- Enterprise Licensing

These initiatives provide robust, flexible solutions that can be developed once and deployed many times. As a result, agencies and localities that cannot afford to buy or build systems can have access to affordable service options.

2005 STRATEGIC GOALS

VITA and the IT Reform initiative have made great strides in garnering early successes, positioning Virginia to meet the demands of a technology-based service environment. In addition to creating a culture of excellence in service delivery, reliability and transparency, the IT Reform effort is viewed by other states as a model for state government reform efforts – not only in IT but also in areas such as human resources, finances, procurement and other functions typically handled on an agency-by-agency basis.

While Virginia can take pride in these early successes, much work remains to be done to truly transform the business of government and service delivery by leveraging the infrastructure, moving to a shared services model and engaging in substantial business process reengineering. VITA is actively seeking private sector partners through the Public Private Education Facilities and Infrastructure Act of 2002 to share in the risks and the rewards of implementing major infrastructure and enterprise applications initiatives. True partnerships and collaboration will ensure future success for VITA and Virginia's IT Reform efforts.

VI. CONCLUSION

As we embark upon a 21st century information-age driven by technology, the Commonwealth of Virginia continues to demonstrate leadership on a local, national and global level through the Office of the Secretary of Technology and its two operating arms, the Virginia Information Technologies Agency (VITA) and Virginia's Center for Innovative Technology (CIT). With this report, the Office of the Secretary of Technology has developed a strategic roadmap and an ambitious agenda to maintain Virginia's leadership in the application of technology to the business of government and to assert itself in emerging industries that will define global economic competition in the twenty-first century.

Virginia today finds itself at a historic crossroads: having overcome a state budget deficit of more than \$6 billion and with an economy that is in the early stages of recovery, Virginia has the opportunity to make investments that can strongly position its economy for the future. This report details potential investment opportunities ranging in total from \$0.5 million to \$40.5 million. These investment opportunities have the ability to generate millions of dollars of economy activity through new jobs, new companies and economic opportunities throughout the Commonwealth in emerging industries that are critical to the future competitiveness of Virginia.

Recognizing the continued stresses and demands placed upon Virginia's state budget, a number of these potential investment opportunities more accurately represent goals of fostering dialogue on issues of importance to the Commonwealth. It is clear, however, that the ability for the Commonwealth to continue to achieve results in the areas for which the Office of the Secretary of Technology is responsible is directly related to maintaining the structure and funding of the programs in place. Increased emphasis on government's ability to reduce costs while offering improved services will require continued support of VITA. Ubiquitous broadband for Virginia's residents will require continued support of CIT's broadband efforts. New economic engines in the fields of nanotechnology, biotechnology and defense and homeland security will require continued support for CIT and investment in programs such as the Commonwealth Technology Research Fund.

Funding for new investments, however, is only one component of the commitment that Virginia must have to achieve continued leadership in technology. With a focus and sustained commitment by the Office of the Secretary of Technology—both to advance leadership in the application of IT to government through VITA and to develop emerging areas of technology such as nanotechnology, biotechnology, and defense and homeland security through CIT—it is clear that Virginia recognizes the challenges and opportunities that lie ahead. By tackling these challenges and seizing new opportunities, Virginia can ensure that the next one hundred years of its storied history are just as prosperous as its first four hundred.